Leveraging Hollywood Set Design Techniques to Enhance Ad Hoc Immersive Display Systems

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Abstract

Over the past four years, the FlatWorld project [1] at the University of Southern California Institute for Creative Technologies has exploited ad hoc immersive display techniques to prototype virtual reality education and training applications. While our approach is related to traditional immersive projection systems such as the CAVE [2], our work draws extensively upon techniques widely used in Hollywood sets and theme parks. Our first display system, initially prototyped in 2001, enables wide area virtual environments in which participants can maneuver through simulated rooms, buildings, or streets. In 2004, we expanded our work by experimenting with transparent projection screens. To date, we have used this display technique for presenting life size interactive characters with a pseudo-holographic appearance.

1. Digital Flat Displays

Since the dawn of the film industry, movie sets have been constructed using modular panels called "flats". Set designers use flats to create physical structures to represent a wide variety of places and activities. For example, a flat can be configured to appear as a room wall, a storefront, or a doorway.

FlatWorld is developing a reconfigurable system of "digital flats". Using large-screen displays and real-time computer graphics technology, a single digital flat can appear as an interior room wall or an exterior building face. Functional doors and windows can also be added to digital flats by constructing physical props that are designed to fit and function in the flat system. For example, by placing a doorframe prop in front of a digital flat, a user can open a real door to view a computer generated view of the world outside.

The FlatWorld approach creates a "mixed reality" blurring the borders between the physical and the virtual elements of a scene. Theme park attractions successfully employ this technique. For example, the enormously popular "Amazing Adventures of Spiderman" attraction at Universal Studios Islands of Adventure (in Orlando, Florida) uses stereoscopic projection screens tightly integrated with physical building facades, props, and other scenery. The props and screens successfully simulate a cityscape complete with deep alleys and vast building corridors.

Other related work is seen in the "Being There" project [3] at the University of North Carolina at Chapel Hill. In this system, walls of white styrofoam blocks are arranged to reproduce the basic layout of a room. Imagery is front projected onto the styrofoam blocks making these surfaces appear as textured walls with virtual windows and doors.

A single room FlatWorld system was constructed in November 2001. This prototype consists of two digital flats and two real walls (Figure 1). Movable door, window, and broken wall props can reconfigure the room's appearance. The physical walls and props were constructed by Paramount Studios. The projection walls are coated 3/4" acrylic sheets. A demonstration was developed using real time stereoscopic graphics (Figure 2), immersive audio, and a number of other effects.

Imagery for each digital flat is provided by a custom stereoscopic rear projection system. Projectors are mounted with passive polarizing filters and driven by PC's. The system's real time audiovisual content was developed using OpenGL and the DirectSound3D programming library. Strobe lights, overhead fans, and other multi-sensory effects devices are controlled using the X10 home automation protocol.

In 2005, we will expand our prototype system to simulate a multi-room space with both interior and exterior environments. We will fabricate the system's components as a series of modular units to enable rapid physical and electronic setup. Our goal is a system that can be dismantled and moved among multiple sites.

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Figure 1. User viewing exterior virtual world through a physical door.

Figure 2. Artistic depiction of stereoscopic display in the FlatWorld System.

2. Transparent Screen Projection System

In 2004, we developed a system which can present life-size, interactive virtual characters with a pseudo-holographic appearance (Figure 3). This holographic illusion effect is created by projecting high-resolution real-time graphics onto specialized transparent optical film. Users interact with the character using a speech recognition engine linked to a statistical classifier which generates the character's responses.

Figure 3: Interactive character projection onto a transparent screen creates the illusion of a hologram.

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4. References

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